Remarks

Specification:

The specification has been amended to replace the word "matrix" with –metric--. As is evident, equations 2-7 define a cell performance metric and not a matrix.

Claims:

Independent claims 1, 13, 17, and 23 have been amended to specifically include the limitations that **both** a cell performance metric and a cluster performance metric are obtained, with the pilot power of the cell being decreased when the cell performance metric is less than the cluster performance metric. Analysis of the art cited Examiner Stevens reveals that the prior art fails to teach or other wise suggest these limitations. As Examiner Stevens has stated, "Rezaiifar does not teach decreasing the pilot power of the cell when the cell performance [metric] is less than the cluster performance [metric]." In order to fill this void, Examiner Stevens uses Valkealahti, stating that Valkealahti teaches adjusting the pilot power corresponding to cell performance. However, this is not what the Applicants are claiming as their invention. The Applicants wish to point out that they are specifically claiming decreasing the pilot power of the cell when the cell performance metric is less than the cluster performance metric.

Because both Rezaiifar and Valkealahti both fail to teach or otherwise suggest the steps of computing a cell performance metric, computing a cluster performance metric, and decreasing the pilot power when the cell performance metric is less than the cluster performance metric, claims 1, 13, 17, and 23 are in proper condition for allowance

Regarding all other claims, since these claims depend from allowable base claims, all other claims are in proper condition for allowance.

No amendment made was related to the statutory requirements of patentability unless expressly stated herein; and no amendment made was for the purpose of narrowing the scope of any claim, unless Applicant has argued herein that such amendment was made to distinguish over a particular reference or combination of references. As the Applicant has overcome all substantive rejections given by the Examiner the Applicant contends that this Amendment, with the above discussion,

overcomes the Examiner's rejections to the pending claims. Therefore, the Applicant respectfully requests allowance of the application. If the Examiner is of the opinion that any issues regarding the status of the claims remain after this response, the Examiner is invited to contact the undersigned representative to expedite resolution of the matter. Finally, please charge any fees (including extension of time fees) or credit overpayment to Deposit Account No. 502117.

Respectfully Submitted,
Calcev, ET AL.

by:

Kenneth A. Haas
Reg. No. 42,614
Phone: (847) 576-6937
FAX: (847) 576-3750

METHOD FOR CONTROLLING PILOT POWER OF A CELL WITHIN A CDMA SYSTEM

FIELD OF THE INVENTION

The present invention generally relates to the field of communication systems. More specifically, the invention relates to a control of pilot power within a Code-Division Multiple Access (CDMA) system.

BACKGROUND OF THE INVENTION

Code-Division Multiple Access (CDMA) is a well-known spread-spectrum physical layer technology for cellular systems. Performance in a CDMA network is strongly affected by the traffic load and the user distribution per cell within the CDMA network. Typically, the pilot powers of each cell within the CDMA network are designed based upon expected traffic loads and measured fading conditions in the field. The pilot powers are then kept constant irrespective of any significant variance in traffic loads and/or fading conditions over time. The result can be a substandard performance of the CDMA network in terms of call drops during significant variations in traffic loads and/or fading condition.

Therefore, it would be desirable to have an adaptive pilot power control to improve the performance of the CDMA network under actual conditions.

SUMMARY OF THE INVENTION

One form of the invention is a method for controlling a pilot power of a cell within a CDMA network. First, a transcoder loss per frame within the cell is determined. Second, a cell performance ~~matrix~~ metric of the cell is computed when the transcoder loss per frame is equal to or greater than a threshold value. The pilot power is controlled as a function of the cell performance ~~matrix~~ metric.

A second form of the invention is a CDMA network comprising a cell and a base station. The base station is operable to determine a transcoder loss per frame within the cell. The base station is further operable to compute

a cell performance ~~matrix~~ metric of the cell when the transcoder loss per frame is equal to or greater than a threshold value.

A third form of the invention is a CDMA network comprising a cell, means for determining a transcoder loss per frame within the cell, and means for computing a cell performance ~~matrix~~ metric of the cell when the transcoder loss per frame is equal to or greater than a threshold value.

A fourth form of the present invention is a computer readable medium storing a computer program for controlling a pilot power of a cell within a CDMA network. The computer readable medium comprises means for determining a transcoder loss per frame within the cell; and computer readable code for computing a cell performance ~~matrix~~ metric of the cell when the transcoder loss per frame is equal to or greater than a threshold value.

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiment, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an overview diagram of one embodiment of a cellular pattern of a CDMA network in accordance with the present invention;

FIG. 2 is a block diagram illustrating one embodiment of a home cell of the CDMA network of **FIG. 1** in accordance with the present invention; and

FIG. 3 is a flowchart illustrating one embodiment of a method for controlling pilot power within the CDMA network of **FIG. 1** in accordance with the present invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

FIG. 1 illustrates a cellular pattern of a CDMA network **10** in accordance with one embodiment of the present invention. The cellular pattern includes a plurality of cells **11-29**. Each cell **11-29** has neighboring

cells forming a cell cluster. The following TABLE 1 lists each cell and its corresponding cell cluster:

TABLE 1

CELL	CELL CLUSTER
11	12-17
12	11, 13, 17-19, 29
13	11, 12, 14, 19-21
14	11, 13, 15, 21-23
15	11, 14, 16, 23-25
16	11, 15, 17, 25-27
17	11, 12, 16, 27-29
18	12, 19, 29
19	12, 13, 18, 20
20	13, 19, 21
21	13, 14, 20, 22
22	14, 21, 23
23	14, 15, 22, 24
24	15, 23, 25
25	15, 16, 24, 26
26	16, 25, 27
27	16, 17, 26, 28
28	17, 27, 29
29	12, 17, 18, 28

Each cell **11-29** includes a base station (not shown) having conventional hardware and software for providing communication service within the corresponding cell. A description of the conventional hardware and software is not provided herein. However, those having ordinary skill in the art will appreciate various conventional methods and devices implemented by the base stations to measure a cell power, a traffic, a frame erasure, a plurality of frames, a transcoder loss per frame, a transcoder loss uplink, a

transcoder loss downlink, and an average energy per chip per interference density measured on the pilot channel associated with the corresponding cell.

FIG. 2 illustrates the home cell **11** in accordance with one embodiment of the present invention. The home cell **11** includes a base station **11a.** In addition to the aforementioned conventional hardware and software, the base station **11a** includes hardware, software or a combination of hardware and software for controlling a pilot power of each cell **11-29** within the CDMA network **10** in accordance with the present invention. **FIG. 3** illustrates a flowchart **30** that is representative of a method for controlling a pilot power of each cell **11-29** within the CDMA network **10** that is implemented by the base station **11a**. In one embodiment, the base station **11a** executes the flowchart **30** for each cell **11-29** over a fixed time interval (e.g., every 8 seconds). The flowchart **30** will now be described herein in the context of an execution of the flowchart **30** for the home cell **11**.

During a stage **S32** of the flowchart **30**, the base station **11a** determines if a transcoder loss per frame of the home cell **11** is less than a threshold value established by actual operational parameters of the CDMA network **10** as would be appreciated by those having ordinary skill in the art. If the base station **11a** determines the transcoder loss per frame of the home cell **11** is less than the threshold value, the base station **11a** proceeds to terminate the flowchart **30**. As a result, the pilot power of the home cell **11** remains constant.

If the base station **11a** determines the transcoder loss per frame of the home cell **11** is equal to or greater than the threshold value, the base station **11a** proceeds to a stage **S34** of the flowchart **30** to compute a cell performance metric for the home cell **11** and a cluster performance ~~matrix~~ metric for the cell cluster associated with the home cell **11**. In one embodiment, the cell performance metric of the cell **11** is computed in accordance with the following equation [1]:

$$CellPerformanceMetric_{11} = \left(\frac{CP_{11}}{T_{11}}\right) \times \left(\frac{FE_{11}}{F_{11}}\right) \times \left(\frac{TLU_{11}}{TLD_{11}}\right) \times \left(\frac{Ec}{Io} Average_{11}\right) \quad [1]$$

In equation [1], CP_{11} is a measured cell power of the home cell **11**, T_{11} is a measured traffic of the home cell **11**, FE_{11} is a measured frame erasure of the home cell **11**, F_{11} is a measured number of frames of the home cell **11**, TLU_{11} is a measured transcoder loss uplink of the home cell **11**, TLD_{11} is a measured transcoder loss downlink of the home cell **11**, and *Ec/Io Average*$_{11}$ is measured energy per chip per interference density measured on the pilot channel of the home cell **11**. The *Ec/Io Average*$_{11}$ can be based upon a Pilot Strength Measurement Message and a Power Measurement Report Message received from each communication device (e.g., a mobile phone) attached to the home cell **11**.

The cluster performance ~~matrix~~ metric is an average of a computation of each cell performance ~~matrix~~ metric of each cell within the cluster. Thus, the base station **11a** would communicate with the base stations of the cell cluster **12-17** to obtain the necessary measured parameters for the following equations [2]-[7]:

$$CellPerformanceMetric_{12} = \left(\frac{CP_{12}}{T_{12}}\right) \times \left(\frac{FE_{12}}{F_{12}}\right) \times \left(\frac{TLU_{12}}{TLD_{12}}\right) \times \left(\frac{Ec}{Io} Average_{12}\right) \quad [2]$$

In equation [2], CP_{12} is a measured cell power of the home cell **12**, T_{12} is a measured traffic of the home cell **12**, FE_{12} is a measured frame erasure of the home cell **12**, F_{12} is a measured number of frames of the home cell **12**, TLU_{12} is a measured transcoder loss uplink of the home cell **12**, TLD_{12} is a measured transcoder loss downlink of the home cell **12**, and *Ec/Io Average*$_{12}$ is measured energy per chip per interference density measured on the pilot channel of the home cell **12**. The *Ec/Io Average*$_{12}$ can be based upon a Pilot Strength Measurement Message and a Power Measurement Report Message received from each communication device (e.g., a mobile phone) attached to the home cell **12**.

$$CellPerformanceMetric_{13} = \left(\frac{CP_{13}}{T_{13}}\right) \times \left(\frac{FE_{13}}{F_{13}}\right) \times \left(\frac{TLU_{13}}{TLD_{13}}\right) \times \left(\frac{Ec}{Io} Average_{13}\right) \quad [3]$$

In equation [3], CP_{13} is a measured cell power of the home cell **13**, T_{13} is a measured traffic of the home cell **13**, FE_{13} is a measured frame erasure of the home cell **13**, F_{13} is a measured number of frames of the home cell **13**, TLU_{13} is a measured transcoder loss uplink of the home cell **13**, TLD_{13} is a measured transcoder loss downlink of the home cell **13**, and *Ec/Io Average*$_{13}$ is measured energy per chip per interference density measured on the pilot channel of the home cell **13**. The *Ec/Io Average*$_{13}$ can be based upon a Pilot Strength Measurement Message and a Power Measurement Report Message received from each communication device (e.g., a mobile phone) attached to the home cell **13**.

$$CellPerformanceMetric_{14} = \left(\frac{CP_{14}}{T_{14}}\right)\times\left(\frac{FE_{14}}{F_{14}}\right)\times\left(\frac{TLU_{14}}{TLD_{14}}\right)\times\left(\frac{Ec}{Io}Average_{14}\right) \quad [4]$$

In equation [4], CP_{14} is a measured cell power of the home cell **14**, T_{14} is a measured traffic of the home cell **14**, FE_{14} is a measured frame erasure of the home cell **14**, F_{14} is a measured number of frames of the home cell **14**, TLU_{14} is a measured transcoder loss uplink of the home cell **14**, TLD_{14} is a measured transcoder loss downlink of the home cell **14**, and *Ec/Io Average*$_{14}$ is measured energy per chip per interference density measured on the pilot channel of the home cell **14**. The *Ec/Io Average*$_{14}$ can be based upon a Pilot Strength Measurement Message and a Power Measurement Report Message received from each communication device (e.g., a mobile phone) attached to the home cell **14**.

$$CellPerformanceMetric_{15} = \left(\frac{CP_{15}}{T_{15}}\right)\times\left(\frac{FE_{15}}{F_{15}}\right)\times\left(\frac{TLU_{15}}{TLD_{15}}\right)\times\left(\frac{Ec}{Io}Average_{15}\right) \quad [5]$$

In equation [5], CP_{15} is a measured cell power of the home cell **15**, T_{15} is a measured traffic of the home cell **15**, FE_{15} is a measured frame erasure of the home cell **15**, F_{15} is a measured number of frames of the home cell **15**, TLU_{15} is a measured transcoder loss uplink of the home cell **15**, TLD_{15} is a measured transcoder loss downlink of the home cell **15**, and *Ec/Io Average*$_{15}$

is measured energy per chip per interference density measured on the pilot channel of the home cell **15**. The *Ec/Io Average*$_{15}$ can be based upon a Pilot Strength Measurement Message and a Power Measurement Report Message received from each communication device (e.g., a mobile phone) attached to the home cell **15**.

$$CellPerformanceMetric_{16} = \left(\frac{CP_{16}}{T_{16}}\right) \times \left(\frac{FE_{16}}{F_{16}}\right) \times \left(\frac{TLU_{16}}{TLD_{16}}\right) \times \left(\frac{Ec}{Io} Average_{16}\right)$$

[6]

In equation [6], CP_{16} is a measured cell power of the home cell **16**, T_{16} is a measured traffic of the home cell **16**, FE_{16} is a measured frame erasure of the home cell **16**, F_{16} is a measured number of frames of the home cell **16**, TLU_{16} is a measured transcoder loss uplink of the home cell **16**, TLD_{16} is a measured transcoder loss downlink of the home cell **16**, and *Ec/Io Average*$_{16}$ is measured energy per chip per interference density measured on the pilot channel of the home cell **16**. The *Ec/Io Average*$_{16}$ can be based upon a Pilot Strength Measurement Message and a Power Measurement Report Message received from each communication device (e.g., a mobile phone) attached to the home cell **16**.

$$CellPerformanceMetric_{17} = \left(\frac{CP_{17}}{T_{17}}\right) \times \left(\frac{FE_{17}}{F_{17}}\right) \times \left(\frac{TLU_{17}}{TLD_{17}}\right) \times \left(\frac{Ec}{Io} Average_{17}\right)$$

[7]

In equation [7], CP_{17} is a measured cell power of the home cell **17**, T_{17} is a measured traffic of the home cell **17**, FE_{17} is a measured frame erasure of the home cell **17**, F_{17} is a measured number of frames of the home cell **17**, TLU_{17} is a measured transcoder loss uplink of the home cell **17**, TLD_{17} is a measured transcoder loss downlink of the home cell **17**, and *Ec/Io Average*$_{17}$ is measured energy per chip per interference density measured on the pilot channel of the home cell **17**. The *Ec/Io Average*$_{17}$ can be based upon a Pilot Strength Measurement Message and a Power Measurement Report Message

received from each communication device (e.g., a mobile phone) attached to the home cell **17**.

Upon receipt of the aforementioned parameters, the base station **11a** computes a cell performance ~~matrix~~ metric for each cell **12-17**, and then averages the computed cell performance ~~matrix~~ metrices to obtain the cluster performance ~~matrix~~ metric.

Upon computing the cell performance ~~matrix~~ metric of the cell **11** and the cluster performance ~~matrix~~ metric of the cell cluster **12-17**, the base station **11a** proceeds to a stage **S36** of the flowchart **30** to determine if the cell performance ~~matrix~~ metric is less than the cluster performance ~~matrix~~ metric. When the base station **11a** determines the cell performance ~~matrix~~ metric is less than the cluster performance ~~matrix~~ metric, the base station **11a** proceeds to a stage **S38** of the flowchart **30** to conditionally decrease the pilot power of the home cell **11**. Otherwise, the base station **11a** proceeds to a stage **S40** of the flowchart **30** to conditionally increase the pilot power of the home cell **11**.

In one embodiment, the home cell **11** is designed with a minimum level and a maximum level for the pilot power of the home cell **11** that are established by actual operational parameters of the CDMA network **10** as would be appreciated by those having ordinary skill in the art. During stage **S38** of the flowchart **30**, the following condition [8] must be satisfied before the pilot power of the home cell **11** is decreased:

$$PP_{CURRENT} - X \geq PP_{MINIMUM} \tag{8}$$

In condition [8], $PP_{CURRENT}$ is the current level of the pilot power of the home cell **11**, X is a number that is either a fixed decrement, a variable decrement, or a decrement equal to a percentage of the current level of the pilot power $PP_{CURRENT}$, and $PP_{MINIMUM}$ is the minimum level established for the pilot power of the home cell **11**. When the condition [8] is satisfied, the current level of the pilot power $PP_{CURRENT}$ is decreased by X.